TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF CARBON TETRACHLORIDE IN THE VADOSE ZONE AND GROUNDWATER

Identification No.: RL-SS01
Date: September 2001

Program: Environmental Restoration
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (s): 200-ZP-1, 200-PW-1
PBS No.: RL-CP01 (RL-ER08)
Waste Stream: Groundwater (200-ZP-1) (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soils (200-PW-1) (Disposition Map Designation: ER-14 [technical risk score 5])
TSD Title: N/A
Waste Management Unit (if applicable): N/A
Facility: N/A

***Priority Rating*:**

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

_X_ 1. Critical to the success of the ACPC
____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
____ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

***Need Title*:** Cost-effective, In Situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater

Need/Opportunity Category: Technology Need

***Need Description*:** In situ remediation of carbon tetrachloride (CCl_4) into simpler elements or compounds is needed to meet an overall remediation goal of source reduction and control of groundwater concentrations below regulatory limits at an established compliance boundary. In situ processes need to be more efficient than current baseline operations. Monitored Natural Attenuation (MNA) is considered as potential remedial measure that may address some portion of the contamination. An improved technical basis for quantifying natural attenuation processes of carbon tetrachloride in the Hanford subsurface is needed to support evaluation of MNA. (Also see Science needs RL-SS33-S, RL-SS34-S, and RL-SS36-S)

Schedule Requirements:

Earliest Date Required: 9/30/00

Latest Date Required: 9/30/09

Pump and treat operations are ongoing for groundwater. Current operations for pump and treat are scheduled for review in FY05. Soil vapor extraction (SVE) operations are ongoing for the vadose zone. The SVE system is currently being reviewed and further enhancements/requirements are being identified. An Innovative Technology Remediation Demonstration program is underway to identify potential final remedies.

***Problem Description*:** Operable unit 200-ZP-1 underlies the Z Plant and T Plant Aggregate Areas located in the northern half of the 200 West Area. This operable unit addresses contamination in the groundwater and saturated zone soils. Carbon tetrachloride, the contaminant of concern, extends in groundwater over a 3.5 square mile area. Depth to the water table is 270 feet. The ultimate remediation goal for the CCl_4 plume is to eliminate a sufficient amount of contamination so that the plume concentration will not exceed 5 ppb at the 200 Area plateau boundary. A description of the groundwater plume and potential clean up scenarios is presented in a problem statement entitled "Carbon Tetrachloride Contamination in Groundwater Problem Statement". This problem statement is available at http://www.bhi-erc.com/technology/tech.htm.

An interim ROD has been issued requiring an interim remedial measure (IRM) to treat the 2000-3000 ppb portion of the carbon tetrachloride plume northwest of Z Plant (excluding the T Plant plume). Contaminated groundwater within this portion of the plume is being pumped from the aquifer, then treated with an air-stripping unit followed by vapor phase granular activated carbon polishing. Initial modeling indicates that pump and treat will need to be expanded significantly and operated over a long time period to meet stated objectives.

Operable unit 200-PW-1 represents the source sites and underlying unsaturated soils in the 200 West Area to which carbon tetrachloride was discharged. Co-contaminants include Pu, Am, and other radionuclides. The 200-PW-1 soil vapor extraction system was an expedited response action that extracts carbon tetrachloride vapor from the vadose zone, and treats the off gas with granular activated carbon. Although this action has successfully removed a large mass of CCl_4, SVE operations generally have reduced efficiency when contaminant removal rates are limited by the time required for contamination to diffuse from less permeable portions of the soil. This appears to be occurring in the 200-PW-1 area because removal efficiencies are declining while as much as 50% of the estimated initial inventory may remain in the soil. It is unlikely that the current SVE can be used to remove a large fraction of the remaining contamination in the vadose zone without significant expansion.

Dense non-aqueous phase liquid (DNAPL) has not been positively identified in the 200 Area, but estimates of initial disposal quantities of CCl_4 indicate that free phase is possible. Therefore, DNAPL detection and potentially treatment in both the vadose zone and aquifer are also concerns.

The Innovative Technology Remediation Demonstration (ITRD) program has been interfacing with Hanford to assist in identifying remediation options for the carbon tetrachloride plume in the 200 West Area. As part of this ITRD project, carbon tetrachloride migration was modeled. The modeling effort suggested that under certain conditions (i.e., selected coefficient values for expected natural attenuation process parameters) it is possible that natural processes can attenuate the plume enough to meet regulatory concentration limit at the defined compliance boundary. Additionally, modeling indicated that characterization or estimation of the mass of carbon tetrachloride source material in the aquifer or that will migrate into the groundwater from the vadose zone in the future needs to be better quantified. A final ITRD project report describing assessment activities, the remediation and characterization technologies reviewed by the ITRD, and recommendations from the project will be completed by December 2001.

Benefit to the Project Baseline of Filling Need: Using the baseline pump-and-treat technology for the plume is projected to require long remediation times with high operational costs. Currently, there is no technology identified that appears to be cost effective in treating the plume. Thus, identifying and implementing a cost effective in situ treatment technology should improve the cost and schedule baseline for the project.

***Functional Performance Requirements*:** Concentration of carbon tetrachloride in groundwater is not to exceed 5 ppb at the defined compliance boundary (approximately 5 km down gradient from the source area). The functional performance requirement for the vadose zone is to enable source reduction of carbon tetrachloride such that the residual contamination will not migrate to groundwater.

Work Breakdown Structure (WBS) No. : 1.4.03.3.1.02.08.17.01 (200-ZP-1) ***TIP No.:*** TIP 0006
1.4. 03.3.1.03.02.25.01 (200-PW-1)

Relevant PBS Milestone: PBS-MC-029

***Justification For Need*:**

Technical: In situ remediation could potentially reduce time and cost of the current soil vapor extraction and groundwater pump and treat processes.

Regulatory: : If not addressed, carbon tetrachloride in groundwater may migrate and exceed the Safe Drinking Water Act standard of 5 ppb at compliance wells.

Environmental Safety & Health: Possible exposure to carbon tetrachloride.

Potential Life-Cycle Cost Savings of Need (in $000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is $50M. This estimate is based on an assumed savings of 5% of the total Hanford groundwater management life-cycle cost of $1.2B.

Cultural/Stakeholder Concerns: Stakeholders may be sensitive to introduction of chemicals into the subsurface to accomplish in situ remediation

Other: None

Current Baseline Technology: Contaminated groundwater is being pumped to the surface, then treated with an air-stripping unit followed by vapor phase granular activated carbon polishing.

Soil vapor is being extracted from the vadose zone with collection of carbon tetrachloride on granular activated carbon; the carbon is regenerated off-site.

Cost: Pump and treat IRM budget forecast is $1.0M for FY02. Costs for complete remediation have not been calculated. However, initial modeling indicates that complete remediation will require a significant expansion of the remediation from the current IRM. Rough estimates for building and operating an expanded pump and treat system range from $50M to $70M.

Soil vapor extraction budget forecast is $0.5M for FY02.

Waste: Spent carbon adsorption material that is regenerated off-site.

How Long It Will Take: Initial modeling indicates complete remediation with pump and treat will take at least 30 years.

End-User: Richland Environmental Restoration Project

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